SCIENCE, AERONAUTICS, AND TECHNOLOGY
FISCAL YEAR 1998 ESTIMATES
BUDGET SUMMARY

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
ADVANCED SPACE TRANSPORTATION TECHNOLOGY

SUMMARY OF RESOURCES REQUIREMENTS

ADVANCED SPACE TRANSPORTATION TECHNOLOGY	FY 1996	FY 1997	FY 1998
Delta Clipper	17,000	--	--
X-33 Advanced Technology Demonstrator	157,500	246,800	333,500
[Stennis Space Center Component Test Facility C of F]	[10,500]	--	--
[Stennis Space Center Test Stand Refurbishment C of F]	--	[2,300]	[3,700]
X-34 Technology Demonstration Program	30,000	36,700	20,000
Advanced Space Transportation Program (ASTP)	29,500	53,200	43,100
Total	**234,000**	**336,700**	**396,600**

Distribution of Program Amount by Installation	FY 1996	FY 1997	FY 1998
Johnson Space Center	900	3,000	2,400
Kennedy Space Center	300	100	400
Marshall Space Flight Center	147,600	274,200	340,800
Stennis Space Center	46,400	6,900	10,300
Ames Research Center	7,700	8,600	6,800
Dryden Flight Research Center	--	6,300	2,700
Langley Research Center	14,300	13,200	5,700
Lewis Research Center	2,900	2,700	3,200
Goddard Space Flight Center	--	100	--
Jet Propulsion Laboratory	3,300	8,700	5,600
Headquarters	10,600	12,900	18,700
Total	**234,000**	**336,700**	**396,600**

ADVANCED SPACE TRANSPORTATION TECHNOLOGY

PROGRAM GOALS

The goal of the Advanced Space Transportation Office is to develop new technologies aimed at revitalizing access to space. These new technologies are targeted to reduce launch costs dramatically over the next decade, and to increase the safety and reliability of current and next generation launch systems.

STRATEGY FOR ACHIEVING GOALS

NASA's primary space launch technology role is to develop and demonstrate pre-competitive, next-generation technology that will enable the commercial launch industry to provide truly affordable and reliable access to space. This in turn should enable the U.S. to recapture leadership in worldwide commercial space transportation in the early decades of the next century. Consistent with the National Space Transportation Policy, NASA, as a member of the national team, will develop technology for the next generation space transportation system, with a target of reducing launch vehicle development and operations costs dramatically after the year 2000. NASA will also participate with the Department of Defense (DOD) in developing technology to improve the competitive position of existing launch vehicles. In addition, NASA will develop, with industry and academia, advanced technology for subsequent generations of launch systems.

This program is divided into the Reusable Launch Vehicle (RLV) and the Advanced Space Transportation Program (ASTP). Incorporating innovative partnerships with industry and academia, the RLV and ASTP programs will prepare the U.S. for key decisions regarding the future development of space transportation systems. NASA funding for Expendable Launch Vehicle (ELV) cooperative technology improvements ended in FY 1996. However, NASA will continue to support DOD (the lead agency) for ELV improvements in areas where NASA's unique facilities and expertise can help government and industry. Moreover, improvements to launch operations applicable to ELV's are an integral part of the RLV program.

NASA is developing a comprehensive space launch strategic plan outlining the Agency's space launch requirements, the current investments in launch vehicle technology development and operations, and the objectives, strategy, budget and key decisions that will enable a future space transportation architecture for NASA. As part of this effort, the RLV criteria are being updated to reflect the program's progress to date. The plan will be completed before the end of FY 1997.

Reusable Launch Vehicle (RLV)

The Reusable Launch Vehicle Flight Program combines business planning and ground-based technology development with a series of flight demonstrators --- the DC-XA, X-34, and X-33. These flight demonstrators incrementally expand the technology and flight test envelope, provide a realistic environment to prove Reusable Launch Vehicle technologies, and demonstrate operability required for low-cost access to space. The RLV program will also provide the necessary business planning to permit industry and the government to commit to revolutionary new space launch systems beginning at the turn of the century.

Key new technologies have already flown in small-scale flight demonstrations on the advanced version of the Delta Clipper-Experimental (DC-X) flight vehicle, now referred to as the DC-XA or Clipper Graham. For example, the first-ever, large-scale composite liquid hydrogen tank, together with composite fuel lines and valves, was flown on the DC-XA in the spring of 1996. This represented the first major flight demonstration and a significant advance in the use of composites for cryogenic application. DC-XA also provided the first significant demonstration of Industry-Government partnerships through the use of Cooperative Agreements. The DC-XA program was scheduled to end in FY 1996 and completed four of five planned flights prior to a mishap on July 31. Despite the mishap, which was unrelated to the new technologies, the DC-XA provided an important first step for the RLV demonstration program. In FY 1997 and FY 1998 the RLV program will consist of the X-34 and X-33 programs (X-33 contains ground and flight technology components).

The X-34 program will demonstrate technologies necessary for a reusable vehicle, but will not be a commercially viable vehicle itself. This allows the X-34 to be more effectively designed as a rocket-powered, Mach-8-capable flight demonstrator test bed to close the performance gap between the subsonic DC-XA and the Mach-15-capable X-33. The X-34 objective is to enhance U.S. space launch capabilities through the development and demonstration of key technologies applicable to future, low-cost, reusable launch vehicles. The X-34, flying in the first quarter of FY 1999, will demonstrate flexible integration capability, high flight rate (25 flights per year), autonomous flight operations, safe abort capability, and a recurring flight cost of $500 thousand or less. The X-34 program is planning to procure two flight articles, a change from the initial plan, but more in keeping with the usual practice in X-vehicle programs; this change will help ensure that the program meets its objectives without constraining the aggressiveness of the demonstration effort.

The 30-month, fixed-price X-34 contract will be conducted by Orbital Sciences Corp. of Dulles, Virginia. Government involvement will include NASA's Ames, Langley, Dryden, Marshall and White Sands complexes and Holloman Air Force Base. Government tasks cover primary propulsion development activity, thermal protection system integration, wind tunnel support and testing and flight operations.

After completion of the first flight series (the basic contract includes two flights), the X-34 program is planning a second phase for additional flight testing of up to 25 flights in one year. These flights will demonstrate key embedded technologies and systems operations, as well as additional technology experiments and test articles from the RLV and Advanced Space Transportation programs. X-34 modifications and experiments will benefit from being comparatively small, thereby lowering the expense and risk of demonstrating the technologies, and making their integration into the vehicle less costly. The low-cost X-34 demonstrator will increase the scope and aggressiveness of flight demonstrations, thus increasing the return to the RLV program.

The X-33 objective is to demonstrate technologies and operations concepts that could reduce space transportation costs to one tenth of their current level, thereby freeing up billions of dollars for technology, science and exploration. As directed in the National Space Transportation Policy, the X-33 program includes two major decision points. The first, whether or not to proceed with Phase II, was completed in July 1996 and was made based on specific programmatic, business planning and technical criteria which had previously been agreed upon by NASA, the Office of Management and Budget and the Office of Science and Technology Policy. The second decision will be made after X-33 ground and flight tests, when Government and industry will consider whether private financing of the full-scale development of an operational RLV (Phase III) should be pursued. At that point, if the industry partners, along with the private capital investment community, are not satisfied that the technological risk is low enough to proceed to full-scale development, NASA may continue RLV technology work to accomplish further risk reduction. For example, the X-33 may require further testing, or a vehicle to test alternative technologies may be needed to prove the ultimate feasibility of an RLV.

NASA is utilizing an innovative management strategy for the X-33 program, based on industry-led cooperative agreements. As a result of industry's leadership of the program, the participants are not playing traditional roles, with government overseeing and directing the work of the industry contractors. Instead, Government participants are acting as partners and subcontractors, performing only those tasks which offer the most effective means to accomplish the program's goals. The Government participants report costs and manpower to the industry team leader (Lockheed-Martin Skunkworks, Palmdale, CA) as would any other subcontractor. Every NASA center except the Goddard Space Flight Center has a negotiated role on the X-33 program. The Industry-led cooperative arrangement allows a much leaner management structure, lower program overhead costs and increased management efficiency.

The FY 1998 budget proposes multi-year appropriations for development of the X-33. The requested appropriations are $329.8 million in FY 1998, $313.9 million in FY 1999 and $75 million in FY 2000. The enactment of these appropriations will ensure the stability to manage and execute this program within its budget and schedule commitments.

The X-33 is an integrated technology effort to flight-demonstrate key technologies, and deliver advancements in: 1) propulsion, including a prototype engine; 2) lighter, reusable cryogenic tanks; 3) application of New Millennium microelectronics for vastly improved reliability and vehicle health management; 4) advanced Thermal Protection Systems to reduce maintenance; and 5) ground and flight operations techniques that will substantially reduce operations costs for an RLV. X-33 will combine its results with the successes of the DC-XA, X-34 and complementary ground technology advances to reduce the technical risk of full-scale development of an operational RLV. The X-33 test vehicle will fly 15 times the speed of sound and will test the boundaries of current technology. Together, the DC-XA , X-34, and X-33 will provide an unprecedented 50-75 flight tests of key technology demonstration prior to a full-scale development decision.

Innovative programmatic and business requirements for an operational commercial RLV will receive equal consideration with technology demonstrations through the development of industry-led business plans. These plans will address policy and legislative issues and private financing options. It is envisioned that private industry will have a primary role in the funding, development, and operation of a next-generation launch system. Therefore, business venture plans are as critical to the RLV program as any technical advancements made on the experimental vehicles.

As directed by Congress, the X-33 program funding includes $10.5 million in Construction of Facilities funding in FY 1996 for completion of the Component Test Facility at Stennis Space Center. The X-33 program also funds refurbishment of the B-2 test stand at Stennis in FY 1997 ($2.3 million) and FY 1998 ($3.7 million) to enable testing of X-33 development and flight engines.

Advanced Space Transportation Program (ASTP)

Continuing the revolutionary advancements in space access that we expect from the RLV Technology Program, ASTP is developing key technologies to dramatically reduce space transportation costs across the mission spectrum. The ASTP will focus on technological advances with the potential to reduce costs beyond RLV goals as well as technology development required to support NASA strategic needs not addressed by RLV. ASTP aims at a cost-to-orbit measured in hundreds, not thousands, of dollars per pound. Major near-term efforts include the Low-Cost Booster Technology (LCBT) project and the Advanced Reusable Transportation Technologies (ARTT) project.

NASA's science enterprises are developing revolutionary new technologies to drive down the size and lifecycle costs of their missions; however, until the initiation of the Low Cost Booster

Technology project, there was no corresponding technology development effort for the smaller launchers to be used for these missions. Without the new technologies to be developed and demonstrated by the LCBT project, launch costs for these missions will remain at current levels, and the proportion of mission resources spent on launch costs will become the "long pole in the tent" as the other costs of each mission are driven down over the next decade.

The LCBT project is investing in innovative technologies for low-cost manufacturing and systems engineering to address this problem. The project will lead to space transportation hardware that does not require the highly specialized, labor-intensive manufacturing and operation of current space transportation systems. For example, the current price of an existing, small-launcher liquid oxygen/kerosene engine is $3-5 million. This program has initiated efforts to drive the costs of such engine systems down to $300-400 thousand and will begin testing priority technologies by the end of FY 1997. The LCBT program funds will be used to develop these subsystem component technologies, which will be integrated into the flight engine for the X-34 flight demonstrator. The funds for the development, integration and test of the X-34 engine system itself, however, have been moved to the X-34 budget element in FY 1997 and FY 1998. The X-34 flight test program is to begin in the first quarter of FY 1999, and it is anticipated that advanced new engine component technologies will continue to be developed by the LCBT program and integrated into the X-34 propulsion system for demonstration throughout its flight program.

The LCBT project has selected nine companies to perform fifteen component development activities as the first phase of the program. These technologies will run in parallel with the X-34 engine development and will be focused on operationally efficient, low-cost hardware at the component and subsystem level. These activities were selected under a NASA Research Announcement (NRA) released in the Spring of 1996. A second program phase is being considered as part of the space launch strategic planning efforts which will be completed before the end of FY 1997. Inclusion of a second LCBT phase will depend, in large part, on programmatic and technical progress during FY 1997, and on the availability of funds. To prepare for a second phase decision, NASA will solicit industry proposals for an integrated development and flight demonstration program, to include a business plan, customer analysis, concept definition and technology plan for a new small booster. It is anticipated that a demonstration effort, if initiated, would be managed as part of the RLV flight demonstration program. The results of this second phase would be intended to support a NASA decision on whether or not to proceed with a procurement of commercial launch services utilizing such an advanced small booster for the University Explorer- (UNEX-) class science payloads. While the UNEX-class boosters represent the first application of these important technologies, it is expected that the advancements will apply to other low-cost reusable liquid booster concepts (e.g., flyback boosters).

The Hybrid Propulsion Demonstration Program (HPDP), begun under a separate project in FY 1995, contributes to the goals of the LCBT project, and thus has been incorporated into the new effort. The HPDP is being conducted under a Cooperative Agreement between NASA, DOD and U.S. industry, with the objective of demonstrating hybrid (solid fuel, liquid oxidizer) propulsion technology to enable U.S. industry to commercialize hybrid boosters for space launch operations. Hybrid motors offer potential for safer, lower cost, and environmentally friendlier boosters for U.S. launch providers. This resource-shared (experts, facilities and dollars) and jointly managed program has already successfully demonstrated small sounding rocket motors, and will soon demonstrate full-size, flight-like boosters. The completion of the HPDP in FY 1999 is designed to allow rapid development of flight hardware with minimum risk, on a schedule supportive of the other elements of the LCBT project.

The Advanced Reusable Transportation Technologies (ARTT) project will target technologies with a goal of a factor of one hundred reduction in current medium-to-large payload launch costs. The early focus of this effort is on rocket-based combined cycle (RBCC) propulsion systems. Four RBCC concepts have been selected for preliminary proof-of-concept ground demonstration in late FY 1997. These demonstrations will lead to a decision in FY 1998 on whether or not to proceed with further development and a flight demonstration project. Technologies will be addressed in partnership with NASA Aeronautics Centers and industry to assure maximum synergy between hypersonic research and the systems design and application to space launch. ARTT also includes a focused advanced materials and TPS activity to develop launch system structures and materials technologies.

The ASTP program also contains funding for the In-Space Transportation project and the Engineering Capability Development effort. In-Space Transportation is a joint effort with the Office of Space Science to support development of advanced spacecraft propulsion systems at Lewis Research Center and the Jet Propulsion Lab. The major project is currently the NSTAR ion propulsion system to be used on the New Millennium Deep Space-1 mission. The Engineering Capability Development budget element supports the Ames Research Center's arcjet facility to enable thermal protection system testing, as well as the development and maintenance of system analytical design tools at Ames and Langley Research Centers.

MEASURES OF PERFORMANCE

Reusable Launch Vehicle (RLV)

Performance Metric	Plan	Actual/Revised	Description/Status
X-33 Phase II Design, Development and Flight Test Approval/Awarded	July 1996	July 1996	OSTP/OMB detailed decision criteria accomplished, approval granted and award made.

X-33 System Requirements Review	August 1996	August 1996	X-33 requirements established and approved.
X-33 Vehicle Systems Preliminary Design Review	November 1996	November 1996	Systems preliminary design review was accomplished for the X-33 vehicle, the first key review milestone
X-33 Environmental Impact Statement Hearings	November 1996	November 1996	Public Hearings as part of Environmental Impact Statement process are required to address X-33 launch and landing site environmental and overflight issues.
LH2 and LO2 Tank Delivery	4th Qtr FY 1997	--	Completes design, manufacture, test and delivery
X-33 CDR	July - August 1997	--	The second key review milestone, which will close the vehicle design for production, validate readiness of the vehicle technologies, and measure schedule to first flight.
First Aerospike Engine Test	February 1998	--	First complete J2-Aerospike test to support first flight unit engine scheduled for delivery in July 1998.
X-33 Thermal Protection System Delivery	April 1998	--	Delivery of complete Thermal Protection System for X-33 flight demonstrator
X-33 Vehicle Rollout	September 1998	--	X-33 flight demonstrator vehicle rollout enabling final checkout
X-33 First Flight	March 1999	--	The flight program, based at Dryden Flight Research Center, will start with relatively low-speed flights (approximately Mach 3) and then expand the flight envelope and vehicle velocity to Mach 15 as confidence is gained in X-33 system performance.
Advanced Space Transportation Program (ASTP)			

Complete ASTP technology road maps and publish final plan.	March 1996	March 1996	Completed on schedule.
NASA Research Announcements (NRA) released for Low-Cost Booster (LCBT)	April 1996	April 1996	Proposals were sought for innovative technologies to enable significant launch cost reductions. Nine proposals for 15 tasks were selected for award. Two proposals from the same company were combined.
Authority to Proceed on LCBT first cycle proposal responses	September 1996	January 1997	One contract awarded October 1996 Three contracts awarded December 1996 Three contracts awarded January 1997
Launch first hybrid sounding rocket from Wallops Flight Facility	December 1996	December 1996	Represents the first in a series of hybrid rocket flights conducted or sponsored by Environmental Aeroscience Corporation (EAC). Fixed-price milestone payment depended on flight occurring on schedule.
Ground Test First Hybrid 250K Motor	2nd Qtr FY 1997	--	Fixed-price milestone payment depends on test occurring on schedule
NSTAR 8000 Hour Ground Test Completion	July 1997	--	Demonstrate life of NSTAR Engine consistent with duty cycle on New Millennium Deep Space I. Test underway with no issues to date.
NSTAR delivery for DS-1 launch	August 1997	--	Delivery of flight hardware will ensure adequate time for checkout and integration into the New Millennium spacecraft.

Rocket-based combined cycle (RBCC) inlet and ejector/ combustor (Mach 0-4) test completion	December 1997	--	Ground test of critical low-speed RBCC technologies such as inlet design and low-speed air augmentation.
Deliver X-34 test flight engine to RLV X-34 project	June 1998	--	Supports LOX/RP flight demonstration on RLV X-34 vehicle in September 1998

ACCOMPLISHMENTS AND PLANS

Reusable Launch Vehicle (RLV)

The DC-XA completed integration and checkout of new, upgraded components in the second quarter, and initiated flight testing in May. The DC-XA completed four test flights but experienced a landing gear failure on flight four and the vehicle was destroyed. The new RLV technologies integrated into DC-XA performed extremely well and successfully completed the first step of the RLV technology program.

The initial X-34 effort combined NASA's need for early technology demonstration with industry's need for a commercially viable small launcher. Unfortunately, our industry partners determined that the current economic viability of the program could not justify their investment and they withdrew. However, NASA's need for the X-34 technology demonstrator remained, and an X-34 NASA Research Announcement was released in the second quarter of FY 1996. The 30-month, fixed-price $60M contract was awarded to OSC in July 1996 for the basic vehicle demonstration program and two flights. The X-34 engine is to be furnished by NASA, and its development and fabrication costs are not included in the OSC contract; nevertheless, the funding for the X-34 engine system development and integration work has now been moved from the ASTP budget element to the X-34 budget line in FY 1997-98.

The RLV program completed demonstrations of technologies critical to meeting the criteria for the 1996 X-33 flight demonstrator (Phase II) decision. The data base on candidate RLV systems/subsystems was expanded significantly with new test results on advanced, low-cost propulsion systems; reusable, light-weight cryogenic tanks and structures; light-weight and low-maintenance thermal protection systems; and vehicle health monitoring and maintenance systems within a highly operable vehicle system.

The decision to proceed with X-33 Phase II was made only after the program underwent an extraordinary amount of independent, external scrutiny and review. An extensive, independent study was completed by a panel of the National Research Council's Aeronautics and Space an independent verification of the criteria, determined that the criteria had been met and recommended proceeding with development of the X-33. Moreover, the X-33 program underwent a NASA Non-Advocate Review (NAR), which also recommended going ahead with Phase II.

Three X-33 industry teams submitted their proposals for Phase II in the third quarter of FY 1996. The evaluation team selected Lockheed Martin Skunkworks and Phase II activities commenced July 2, 1996, following Administration approval.

The Lockheed Martin X-33 program consists of significant ground technology and flight demonstration of key RLV technologies, including an innovative aerospike propulsion system, metallic thermal protection systems and light-weight, robust, composite cryogenic tanks in an efficient lifting-body design. Operational goals of the vehicle are to: eliminate re-certification between flights; significantly reduce turnaround inspections; eliminate engine gimbals and flex lines to reduce reflight maintenance and operations; provide engine-out capability with return to launch site; and improve operability by incorporating modular components that are accessible without removal.

FY 1997 is a critical year for the X-34. The project team will conduct all major technology development work, and will complete design of the test vehicle's thermal protection, main engine propulsion, and avionics and control systems. L-1011 launch platform modifications and preliminary airframe integration will also be done. System design freeze and associated reviews will be conducted in the third quarter of FY 1997 in anticipation of first flight in the first quarter of FY 1999.

X-33 Preliminary Design Review (PDR) was completed in November 1996 and represented the first critical milestone regarding technology maturity and schedule to first flight. Subsequent X-33 program activities in FY 1997 will focus on flight vehicle design and development and on a comprehensive ground test program emphasizing a full-scale RLV prototype engine and lightweight composite hydrogen and oxygen tanks. The X-33 linear aerospike engine, main propulsion system, liquid oxygen tank, hydrogen tank and reaction control system (RCS) Critical Design Reviews (CDR) will be completed during the second quarter. The standoff structure CDR and release of the draft Environmental Impact Statement (EIS) will be finished during the third quarter. The Thermal Protection System (TPS), subsystems and software, and the ground systems and operations CDRs will be completed during the fourth quarter. These CDRs represent the most critical milestones regarding technology maturity and schedule to first flight (scheduled for FY 1999). The final EIS including the record of decision will be completed by the end of FY 1997. X-33 integration, assembly and test tooling buildup will be initiated. RLV efforts will also include system definition and business planning efforts required to support private sector and government investment options for the Phase III decision.

FY 1997 Funding includes $2.3 million in CoF funds for test stand modifications at the Stennis Space Center. These modifications are required to allow testing of X-33 development and flight engines.

The FY 1998 X-34 effort will primarily be focused on final airframe integration, technology experiment development, pre-flight testing and final engine checkout. The basic X-34 contract will in essence be completed, with the exception of the first two flight tests, which will be conducted in the first quarter of FY 1999. Up to 25 flights per year will be performed under an option to the contract in FY 1999 after completion of the basic contact.

X-33 FY 1998 program activities will continue effort of FY 1997 and focus on flight vehicle design and development and on the comprehensive ground test program. The liquid oxygen and liquid hydrogen tanks will be delivered during the first quarter, with other hardware deliveries scheduled through the year. The X-33 linear aerospike engine testing will begin late in the second quarter. X-33 flight vehicle integration and final assembly will be initiated in anticipation of X-33 rollout early in FY 1999. The PDR for the RLV prototype engine (YRS-2200) will be completed during the second quarter in anticipation of the CDR early in FY 1999. RLV efforts in FY 1998 will also continue system definition and business planning efforts in preparation for the Phase III decision.

FY 1998 funding includes $3.7 million in CoF funds for test stand modifications at the Stennis Space Center. These modifications are required to allow testing of X-33 development and flight engines.

Advanced Space Transportation Program (ASTP)

A NASA Research Announcement (NRA) for Low-Cost Booster Technologies (LCBT) components was released in April 1996, resulting in thirty-four first-cycle and 14 second-cycle proposals submitted for evaluation. Seven first-cycle proposals and two second-cycle proposals were selected for award, with the first agreement signed in October 1996, and the rest to be signed by January 1997. Substantial resources were invested in the LOX/RP Propulsion Test Article (PTA) which will support ground testing of both the X-34 engine and components from the NRA. A preliminary requirements review (PRR) on the PTA was completed in June 1996, the preliminary design review (PDR) was done in August, and critical design review (CDR) was completed in December. A RFP for procurement of the testbed engine, including the X-34 engine, was completed in August. All X-34 engine system development, integration and procurement funding is moved to the X-34 budget element in FY 1997-98, although advanced component technologies will continue to be funded in the LCBT project.

A NASA Research Announcement for Advanced Reusable Transportation Technologies (ARTT) was released in April 1996. Five contracts have been awarded for the definition of rocket-based combined cycle (RBCC) conceptual vehicle design approaches, ground testing of components and engine concepts, and proof-of-concept design definition. Efforts have also been initiated to develop an Advanced Structures and TPS Technology Plan focused on the development of generic technologies related to primary structure, cryotank structure and thermal protection systems.

Consolidation of propulsion testing activities was initiated at the Stennis component test facility in FY 1996 for $45.5 million, including $10.5 million of CoF funds. This investment will complete the facility originally intended to be used by the Space Transportation Main Engine, and will provide a state-of-the-art capability to test rocket engine components and subsystems for the RLV and ASTP programs.

In FY 1997, LCBT efforts will focus on continuing the work under the NRAs, in order to develop and demonstrate these technologies to the level required for industry to consider them viable for inclusion in their proposals for Phase II of the LCBT project -- the integrated flight demonstration phase. Multiple industry-led studies will be conducted to address the business and technology needs of a small, low-cost booster. Initiation of Phase II is dependent on the outcome of the space launch strategic planning effort, on overall LCBT program progress, on the results of the industry-led studies and on the availability of funds. It is anticipated that, if initiated, Phase II would be managed as part of the RLV flight demonstration program.

Advanced Reusable Transportation Technologies contractors will complete their individual concept definition reviews and initiate ground testing of RBCC Mach 0 - 4 test hardware in FY 1997. Testing of critical component technologies will be in progress.

The Hybrid Propulsion Development Program (HPDP) will complete most of the smaller component development testing and database generation, and will conduct extensive demonstration tests of large, 250,000-pound-thrust motors in FY 1997. Several sounding rocket flight demonstrations will be conducted.

Engineering Capability development will continue to fund utilization, maintenance, and productivity upgrades for the premiere national facilities at LaRC and ARC required to accomplish the goals of the Advanced Space Transportation programs.

FY 1998 LCBT funding supports extensive component testing of technologies developed under the Phase I NRAs, with the goal of upgrading the X-34 engine using these components, and then possibly flight-demonstrating them using the X-34. Initiation of LCBT Phase II will depend on the outcome of the space launch strategic planning effort, on overall LCBT program progress and on the availability of funds.

Also in FY 1998, Advanced Reusable Transportation Technologies contractors will demonstrate, on the ground, higher Mach operation into the ramjet and scramjet operating modes, as well as transition between operating modes.

NSTAR ion propulsion system launch on New Millennium DS I is scheduled for the third quarter of FY 1998. Subsystem level integration and testing will be conducted during FY 1998 for a Solar Thermal upper stage flight experiment.

The FY 1998 Hybrid program will continue testing 250,000-pound-thrust motors, including flight-like motors. Engineering Capability development will also continue to be supported.